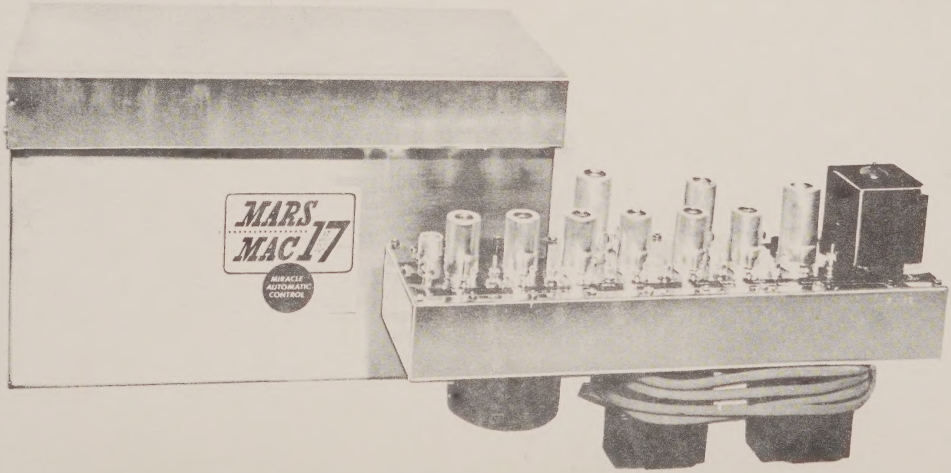
MARS MAC 17

17 VOLT OUT-PUT

MIRACLE AUTOMATIC CONTROL

MID AMERICA RELAY SYSTEMS, INC.
601 Main Street Rapid City, South Dakota


MARS
MAC 17
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AUTOMATIC
CONTROL

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DESCRIPTION
M.A.C. 17

The M.A.C. 17 is an advanced V.H.F. Translator designed to convert any V.H.F. channel to any other non-adjacent channel. Power output is adjustable from ¼ watt to one watt. It incorporates single chassis construction and a choke filtered power supply. All tubes are industrial types operating at far less than their rated dissapations.

The optical identifier has no contact points and incorporates two continuous motion discs.

The automatic shut off has three to five minutes delay, and reduces plate power to all stages when parent station leaves the air. This multiplies tube life. Preamplifiers should be used with all dual conversion units and all others operating with less than 200 microvolts input.

(1) Emmissions: Translation A 5 / F 3
Identification A 1

(2) Frequencies: (input and output)

Channel	Carriers (mc) Video	Audio	Band (mc)
2	55.25	59.75	54-60
3	61.25	65.75	60-66
4	67.25	71.75	66-72
5	77.25	81.75	76-82
6	83.25	86.75	82-88
7	175.25	179.75	174-180
8	181.25	185.75	180-186
9	187.25	191.75	186-192
10	193.25	197.75	192-198
11	199.25	203.75	198-204
12	205.25	209.75	204-210
13	211.25	215.75	210-216

(3) Power Rating: 1 watt Peak Video R. F. Output
½ watt Audio R. F. Output
(or less upon request of the customer)

Final Amplifier Tube: Type: 6360 Dual Tetrode in Class A Push-Pull

Plate-Cathode Voltage (both units)	110 volts
Plate Current (total both units)	55 ma.
Plate power input (total both units)	6 watts
Screen Voltage (both units)	105 v
Screen current (total both units)	5 ma.
Screen power input (total both units)	.55 watts
Grid-cathode voltage	-5 volts
Grid current (class A)	0 ma.
Heater Voltage	6.3 v.a.c.
Heater current	.8 amp.
Plate efficiency (at 1 watt peak video and ½ audio)	15%

(5) Tube Functions: Single conversion unit

5654	V_1	is a pentode R. F. amplifier for the input channel.
5654	V_2	is a pentode R. F. amplifier for the input channel.
5654	V_3	is a pentode R. F. amplifier for the input channel,
5654	V_4	is a pentode mixer amplifier, input is received channel. and local oscillator and output is transmitted channel.
5654	V_5	is a pentode R. F. amplifier for the output channel.
5654	V_6	is a pentode R. F. amplifier for the output channel.
6922	V_7	is a dual triode, grounded grid, R. F. amplifier for the output channel.
6360	V_8	is a dual tetrode final Class A R. F. amplifier for the output channel.
6922	V_9	is a dual triode, ½ of which is used as a crystal overtone oscillator.
	V_{10} V_{11} V_{12} V_{13}	are 500 ma silicon rectifiers.
2N336	V_{14}	is a D. C. amplifier silicon transistor A.G.C.
1N34A	V_{15}	is a A.G.C. detector diode.
1N34A	V_{16}	is the output power monitor diode.

Dual conversion unit.

5654	V_1	is a pentode R. F. amplifier for the input channel.
5654	V_2	is the first mixer amplifier.
5654	V_3	is an intermediate frequency amplifier. (optimum I.F. chosen for each conversion.)
5654	V_4	is the second mixer amplifier.

All other stages have same function as single conversion except both triode sections of V_9 are used as crystal overfone oscillators.

(6) Circuit diagrams, (Attached)

(7) Block diagrams, (Attached)

(8) Operational description: (includes autofier and oscillator details)

The input signal to the M.A.C. 17 may vary within the limits of 150 to 5000 microvolts. Other ranges should use external amplification or attentuation. Input is pie match for low pass characteristics.
Single conversion units have three stages of pentode R. F. amplification on the incoming channel with staggar tuning and resistive shunting for required band width.

Difficult conversions where images or harmonics are involved require dual conversion. These have one stage of pentode R.F. amplification followed by a mixer and I.F. (pentodes). From this point on both single and dual conversion units are identical.

The fourth stage is a pentode mixer with output on the transmitted channel. This is followed by a pentode R. F. amplifier and a push-pull grounded-grid dual triode. The final stage is a 6360 dual tetrode push-pull operating at about one half its rated dissipation and Class A. The output is coupled thru a low pass filter to reduce harmonics.

Two traps are incorporated, one for the conversion oscillator frequency and the second for any other required frequency.

All stages are shielded separately and a small chassis is used to prevent "wave-guide" chassis action. This enables high gain circuitry without problems of feed-back or instability.

The conversion oscillator uses an overtone crystal oscillator with feedback coupling variable to the cathode. This enables the level to be adjusted such that tuning the oscillator tank will not cause the crystal to loose control of the frequency. It will not oscillate when detuned.

Dual conversion units use both sections of the 6922 dual triode in separate over-tone oscillators, with all components identical to those shown in the single conversion schematic.

Crystals used are International F A-5, or equivalent, with advertised .01% calibration tolerance. These usually have far closer tolerance on the even megacycle multiples which are always used.

The code identifier is operated by carrier interruption. This is accomplished by biasing the A.G.C. amplifier transistor to cause cut off of the A.G.C. controlled stages. A phoho dual diode conducts when the optical path is opened by a code disk with half intervals. These are both in continuous motion one at one rev/min, the other one rev/hr.

Shut off is accomplished when the parent station leaves the air by switching off plate and screen power to the final state. Plate voltage to other stages is reduced during shut off by the same circuitry.

A thermostatic housing temperature control option prevents the temperature from falling below 40 degrees when the unit is operating in an unheated building and cold climate.

SPECIFICATIONS
M.A.R.S. MAC 17

	Typical	Limit
Gain	100 db	94-106 db
A.G.C. Control	40 db for 2 db output change	30 db for 2 db output change
Harmonics at output	70 db down or more	-60 db
Emissions beyond 3 mc from channel edge	40 db down or more	-30 db
Total conversion oscillator deviation with calibration, voltage, (85% to 115% of 115 v A. C.) and temperature. (-30 degree C to plus 50 degree C)	.01%	.02%
Operating voltage	115v 60 cycle A. C.	90-130 v 60 cycle A. C.
Power Consumation		
Parent Station On	35 watts	30-40 watts
Parent Station Off	30 watts	25-35 watts
Power Output	.95 Watt Peak Video R. F. .40 Watt Audio R. F. (May be operated at lower powers at customers request.)	.9-1 watt peak video R. F. .3 to .5 watt audio R. F.

POWER DATA
MAC . 17

TUBE	5654 (Plate & Screens)	6922 osc (Plates)	6922 amp (Plates)	6360 amp (Plates)
AVERAGE DISSAPATION	.77 watts	.29 watts	.9 watts	6 watts
RATED DISSAPATION	2.2 watts	1.5 watts	1.5 watts	11 watts
% of RATING	35%	19%	60%	55%
LIFE EXPECTANCY	1-2 years	2-3 years	1-2 years	1-2 years

SILICON RECTIFIERS ARE RATED AT 500 ma AND OPERATED AT 120 ma WITH TWO IN SERIES TO INSURE AGAINST FAILURE.

SILICON A.G.C. TRANSISTOR IS OPERATED AT 20% ITS RATED VOLTAGE AND LESS THAN 10% ITS RATED CURRENT.

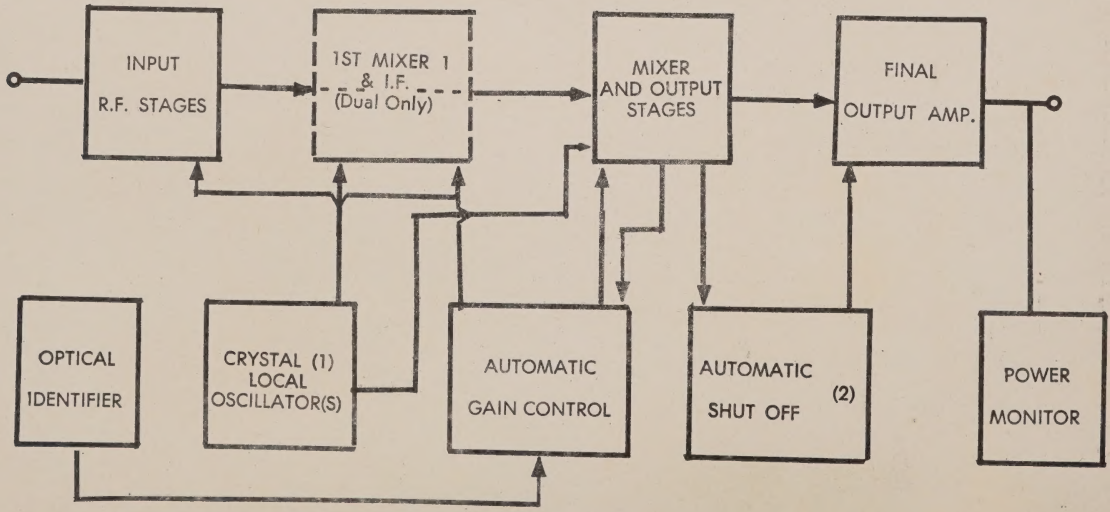
PHOTO DUAL DIODE IS OPERATED AT LESS THAN 30% OF ITS RATINGS.

VOLTAGE CURRENT DATA

(Single Conversions)

		Signal Input 1 mv	No Signal
Plate & Screen	Pin 5&6	110 volts	62 volts
Average Current		7 ma	4 ma
Grid Voltage	Pin 1	-3 volts	-2 volts
Plate & Screen	Pin 5&6	100 volts	77 volts
Average Current		4 ma	2.4 ma
Grid Voltage	Pin 1	-3 volts	-2 volts
Plate Voltage	Pin 1&6	110 volts	62 volts
Current per Triode		8 ma	4 ma
Grid Voltage	Pin 2&7	-2.5 volts	-2.5 volts
Plate Voltage	Pin 6&8	110 volts	25 volts
Plate Current		55 ma	0 ma
Screen Voltage	Pin 7	105 volts	25 volts
Screen Current		5 ma	0 ma
Grid Voltage	Pin 1&3	-5 volts	-5 volts
Plate Volts		40 volts	32 volts
Current per Triode		6 ma	4.5 ma
TOTAL POWER CONSUMPTION		35 watts	30 watts
FINAL STAGE EFFICIENCY		20-25%	

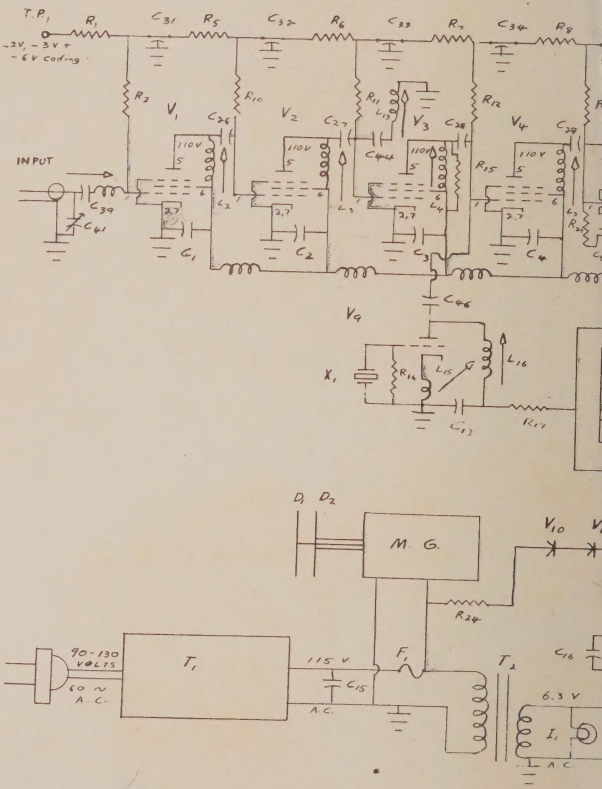
MAC-17 BLOCK DIAGRAM



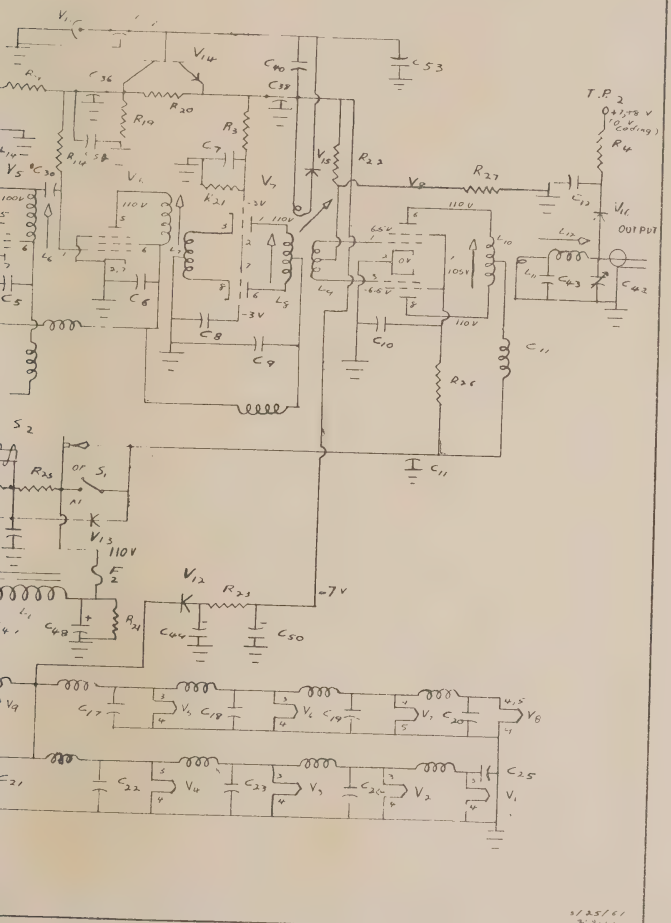
(1) Dual conversion with two local oscillators used only where required, (No change in tube compliment)

(2) Automatic shut off includes "miracle control" which reduces power to all stages when parent station is not operating.

M.A.R.S. MAC-17 V.H.F.



T.V. TRANSLATOR



ALIGNMENT
MARS MAC 17

(1) Operate unit for 8 hours on and 4 hours off for 30 hours before alignment.

(2) Measure oscillator injection to grid of V_4 (pin 1) using a V.T.V.M. on negative position. Adjust L_{16} for maximum reading then adjust coupling of L_{15} for -3 volts on pin 1. Repeat these two steps. Measure oscillator frequency at output of unit using a sensitive narrowband R. F. Meter such as the Blonder-Tongue F.S.M.-1. Tune L_{16} toward lower inductance position for -2.75 volt reading on V.T.V.M. Adjust L_{14} for minimum reading on R. F. Meter. Repeat step two at grid of V_2 (Dual conversion)

(3) Use a sweep and crystal marker with audio and video markers on all channels (such as Kay Electric Co. Marka Sweep) to observe overall response into a 75 ohm load. With A.G.C. fixed at -3 volts peak L_{10} L_7 L_5 L_3 and C_{42} video marker. Peak L_8 L_6 L_4 and L_2 at audio marker. Center L_1 and C_{41} on channel.

"Touch Up" for flat curve (within 3 db) by slight adjustments of each inductance. Check adjacent channel markers.

(4) Inject a 5000 microvolt peak visual and 3500 microvolt audio signal into the 75 ohm input. Adjust coupling of A.G.C. loop to L_8 for 8.5 volts visual output at 75 ohm in R. F. Meter. Check A.G.C. action in six 6 db steps down and back up. Check intermodulation products at 4.5; 9 and 13.5 mc above and below carriers.

(5) Measure harmonics, conversion immages, and all other possible spurrious frequencies. If any limits are exceeded install capacitive coupled quarter wave coax or other necessary traps.

(6) Check action of identifier, automatic shut off, and shut off delay.

(7) Use Harmonics of 2 mc oscillator zero beat with W.W.V. at 10 mc to check by direct beat method the conversion oscillator frequency accuracy. (All conversion frequencies used are multiples of 2 mc).

EQUIPMENT USED FOR ALIGNMENT

(a) Kay Electric Co. Marka Sweep. Model R.F.P.
(with crystal controlled audio and video markers on each channel)

(b) Heath Kit Model 0-8 oscilloscope.

(c) Heath Kit (calibrated) V.T.V.M., V-6

(d) Blonder Tongue F.S.M.-1 Field Strength Meter
(with sepcial calibration of frequency and amplitude)

(e) Two M.A.T. Blonder Tongue 75 ohm variable attentuators.

(f) Demodulator Probe, 75 ohm input.

(g) B-K Dynascan Video Generator Model 1000

(h) Triplett 2432 Signal Generator

(i) Cables, Couplers, etc.

(j) MARS crystal controlled adjustable zerobeat 2 mc tunnel diode oscillator, with harmonics over 100 microvolts each 2 mc to over 200 mc

(k) Short wave receiver and antenna for W.W.V. 10 mc

(l) Harmonic measurement equipment. (U.H.F. oscillator into diode mixer with fundamental trap in coupling circuit to output of translator R.F. meter used as calibrated I.F. meter preceeded by step attentuators for I.F. frequency)

MAC 17

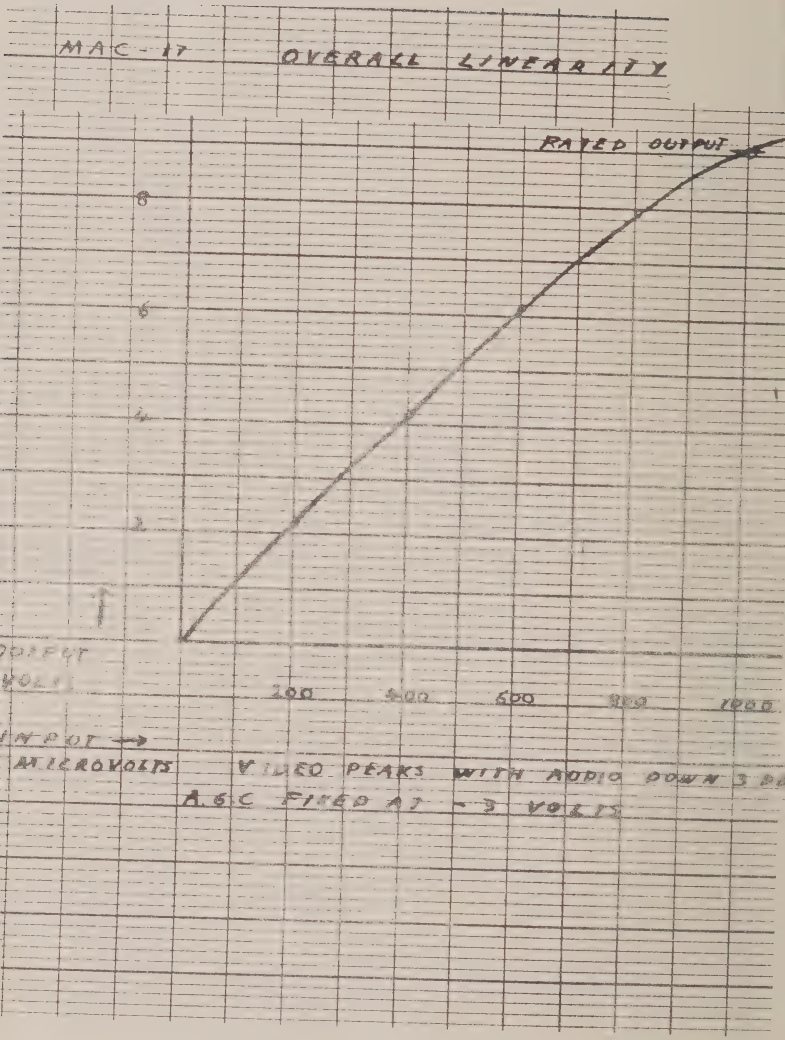
PARTS LIST

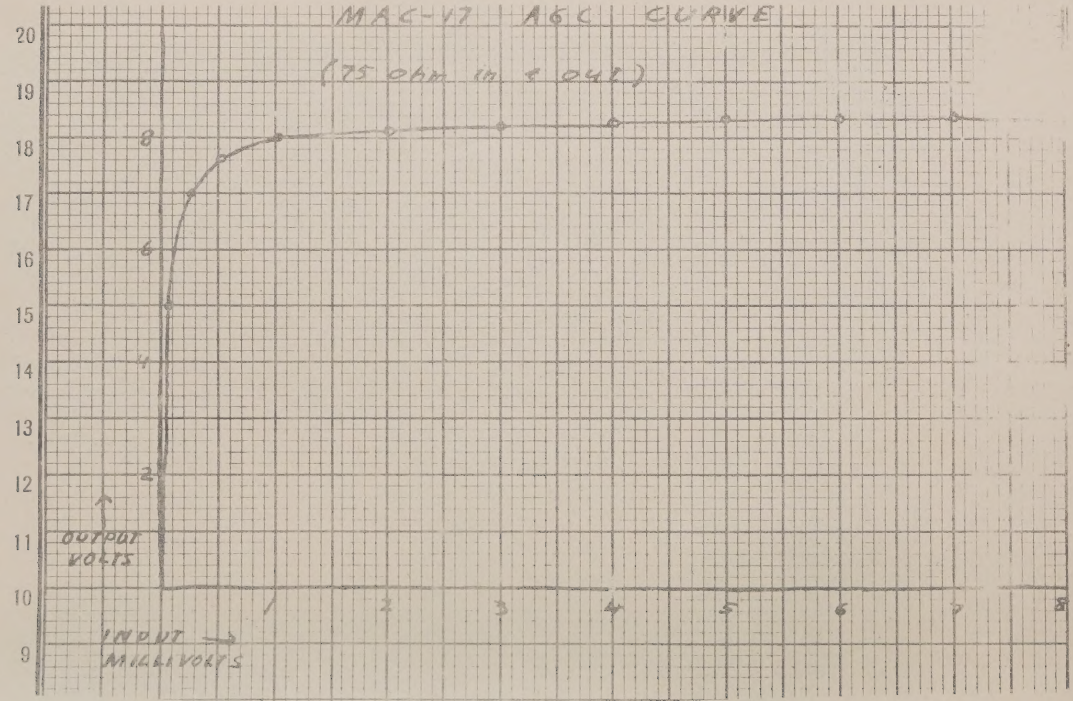
V_1 V_2 V_3 V_4 V_5 V_6	5654/6AK5W
V_7 V_9	6922/E88CC
V_8	6360
V_{10} V_{11} V_{12} V_{13}	500 ma Silicon-rectifiers
V_{14}	2N336 N.P.N. Transistor
V_{15} V_{16}	1N34A Diodes
V_{17}	1N2175 Photo Dual Diode
X_1	Overtone Crystal .01% Calibration
S_1	Single Pole Switch
S_2	5000 ∽ sensitive relay (Potter Brumfield PW-5LS or equivalent)
T_1	50 V.A. Isolation and regulation Transformer 90-130 V 60 cycle input 115 V output
T_2	6.3 V Heater Transformer Stancore P-4019 or equivalent
L_1	4 Henry choke, 100 ∽ resistance Stancore C-1410 or equivalent
M.G.	Motor and Gears for 1 rev/min and 1 rev/hr.
D_1	Code aperture disk (drilled for call letters)
D_2	Half hr interval disk, 2 aperture
I_1	#51 Bulb
F_1	4/10 amp M.D.L. slo-blow fuse
F_2	1/8 amp A.G.C. fast blow fuse
L_2 L_{16}	R.F. Coils, value vary with conversions

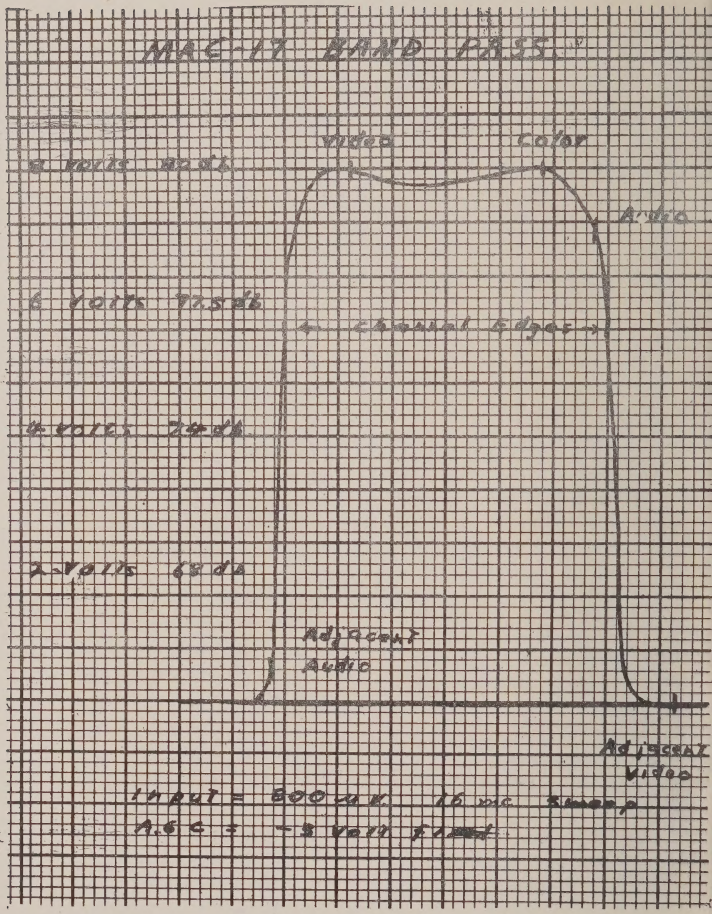
All unmarked coils R.F. Chokes 20 turns #22 enamel, 1/8 inch close wound.

All Resistors 10% tolerance 1/2 Watt unless otherwise stated.
All Capacitors Ceramic disk 1000 Volt 20% tolerance unless otherwise stated.

R_1 R_2 R_3 R_4 R_{19} R_{22}	=	15,000 ohms
R_5 R_6 R_7 R_8 R_9	=	6,800 ohms
R_{10} R_{11} R_{12} R_{13} R_{14}	=	2,700 Lo Band 470,000 Hi Band and 470,000 to mixer grids
R_{15}	=	4700 (Lo Band only)
R_{16}	=	100,000 ohms
R_{18}	=	2,700 ohms
R_{20}	=	33,000 ohms
R_{21}	=	100,000 ohms
R_{23} R_{26}	=	1,000 ohms
R_{24}	=	10 ohms 1 watt 20% tolerance
R_{25}	=	2000 ohms 10 watts
R_{27}	=	470,000 ohms
R_{28}	=	47,000 ohms
C_1 C_2 C_3 C_4 C_5 C_6 C_7 C_8 C_9 C_{10} C_{12} C_{13} C_{14} C_{15} C_{16} C_{17} C_{18} C_{19} C_{20} C_{21} C_{22} C_{23} C_{24} C_{25}	=	470 mmf capacitors
C_{26} C_{27} C_{28} C_{29} C_{30}	=	4.7 mmf N.P.O. ceramic Capacitors
C_{11} C_{31} C_{32} C_{33} C_{34} C_{35} C_{36} C_{37} C_{38}	=	1000 mmf feed thru ceramic capacitors
C_{39} C_{40}	=	100 mmf capacitors
C_{41} C_{42}	=	5-30 mmf tubular trimmers or fixed ceramic at correct value for match
C_{43}	=	Ceramic, depends upon channel
C_{44} C_{45} C_{46}	=	1 mmf N.P.O. Ceramic capacitors
C_{47} C_{48}	=	30 mfd 150 volt electrolytic capacitors
C_{49} C_{50} C_{51}	=	150 mfd 15 volt electrolytic capacitors
C_{52} C_{53}	=	5 mfd 15 volt electrolytic capacitors


MAC-17 OVERALL LINEARITY
RATED OUTPUT
8
6
4
2
200
400
600
1000
MICROVOLTS
VIDEO PEAKS WITH AUDIO DOWN 3 DB
A.G.C FIXED AT -3 VOLTS


MAC-47 AGC CURVE
(75 ohm in & out)
OUTPUT VOLTS
INPUT MILLIVOLTS


MAC-11 BAND PASS
8 volts 80db
6 volts 77.5db
4 volts 74db
2 volts 68 db
video
Color
Audio
Adjacent
Audio
Adjacent
Video
input = 500 uv
AGC = -3 Volt

TEST DATA MARS MAC- 17

(a) Serial Number & Conversion ....

(b) Call Letters Assigned .....

(c) R.F. power output
Video R.F. .....
Audio R.F. .....

(d) Final Plate
voltage .....
current .....
power input .....

(e) Frequency Accuracy
Conversion Oscillator
(1) - 30 degrees C .....
(2) + 30 degrees C .....
(3) + 50 degrees C .....
(4) Change 85% to 115%
supply voltage .....

(f) Spurious emissions at output (db down from 1 watt)
2 x video carrier .....
3 x video carrier .....
2 x audio carrier .....
3 . audio carrier .....
Maximum all other harmonies
through 10th .....
Conversion oscillator .....
2 x Conversion oscillator .....
Video input freq. .....
Audio input freq. .....
Intermodulation Products
Sound plus 4 1/2 mc .....
Sound plus 9 mc .....
Video minus 4 1/2 mc .....
Video minus 9 mc .....
Maximum all other intermodulation
products .....
All other Spurious Emissions .....
Maximum

(g) Emissions from power line and
housing with terminated output.....

*STAINLESS STEEL HOUSING

**POLISHED COPPER CHASSIS

***INDUSTRIAL TUBES PREMIUM QUALITY

*****FULL TWO YEAR WARRANTY

*****MONEY BACK GUARANTEE

*******OPTICAL IDENTIFICATION

THE AMAZING MAC SERIES OF ADVANCED
VHF TRANSLATORS
(AHEAD by 5 YEARS)
Full One Watt Power Output

Dealers Net Price $700 List Price $933
Direct Manufacturer to Dealer Sales Policy
MID AMERICA RELAY SYSTEMS RAPID CITY S. DAK.